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Inorganic and Hybrid Glasses From Zeolitic Frameworks

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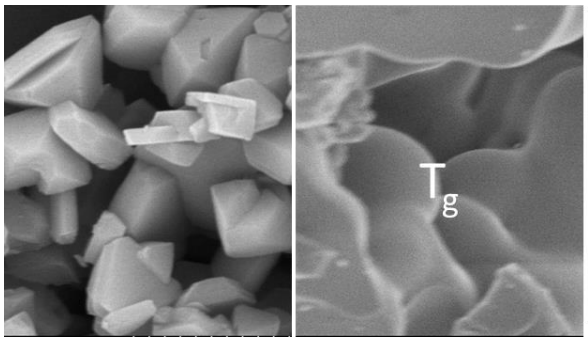
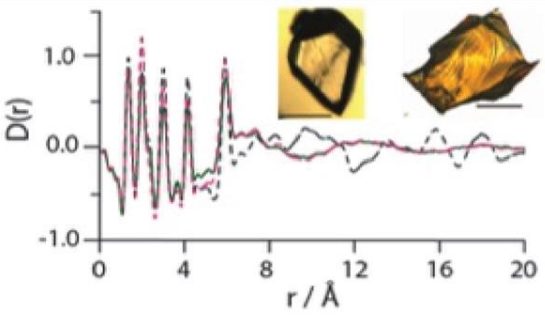
Zeolites are metastable crystals with enthalpy greater than melt-quenched glasses of the same composition[1]. Since 2003 we have pioneered the collapsing of zeolites to create amorphous phases[2]. These glasses form via low energy routes - close to the glass transition T_g at ambient pressure, or with modest pressures at room temperature. By following such processes dynamically we discovered a low density low enthalpy amorphous phase approximating to a 'perfect glass', being topologically equivalent to the starting zeolite and sharing collective THz vibrations[3]. Amorphization then proceeds via a liquid-liquid transition to a high density polyamorph of higher enthalpy. Subsequent thermal processing, often results in crystallization before final melting, from which a melt-quenched glass can be formed – all with the same inorganic composition. Very recently we have discovered[4] that similar processes occur in metal organic frameworks (MOFs)[5], when they are thermobarically stressed. These procedures are leading to new glasses, including melt-quenched hybrid glasses, with organic-inorganic structures - for example, Zn^{2+} nodes interlinked by imidazolate ($C_3H_3N_2^-$) ions. Moreover, by connecting amorphization and melting phenomena together with respect to network topology, hypothetical melting points, based on predicted T_g values, can be used to explain why some MOF structures have achievable melting temperatures while others decompose first.





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